1. Program objectives

The main objective of this program is to educate skilled applied mathematicians, well prepared for advanced industrial positions or continued graduate studies.

Knowledge and understanding

A Master of Science in Applied and Computational Mathematics will:

• have a broad knowledge in applied mathematics as well as a significantly deepened knowledge within the chosen area of specialization, including techniques of mathematical modelling, analysis of mathematical models, and simulation,

• be able to, in an independent manner, apply mathematical theories, methods and models,

• be able to formulate and approach new problem settings in a scientific manner, by having a creative, critical and systematic attitude towards applied mathematics.

Skills and abilities

A Master of Science in Applied and Computational Mathematics will be able to:

• formulate mathematical models, choose suitable methods to investigate those models including the efficient use of computer tools,

• analyze different mathematical models within science and technology and work creatively, systematically and critically,

• work out solution strategies to important classes of mathematical problems, knowing the capabilities and limitations of different methods and tools,

• work efficiently in a teamwork environment,

• communicate results and conclusions in a competent and intelligible manner, both orally and in writing, with management, experts, and society at large,

• follow and participate in research and development related to the chosen specialization.

Ability to make judgments and adopt a standpoint

A Master of Science in Applied and Computational Mathematics will be able to:
• critically judge validity and limitations of the results obtained from different types of
mathematical models,
• identify the need for further knowledge in the field and take initiatives to keeping the
personal knowledge up to date.

Beyond this, the goals for Master’s degrees defined in the Higher Education Ordinance and the
local degree policy of KTH apply.

2. Extent and content of the program

Applied and Computational Mathematics is a two-year (120 university credits) Master’s program
on the advanced level (second cycle). The instruction language is entirely English. The program
consists of a basic curriculum followed by three tracks: (i) mathematical statistics and financial
mathematics, (ii) computational mathematics, and (iii) optimization and systems theory. The
courses in the basic curriculum are compulsory and worth 30 university credits. To obtain
sufficient depth in a track, a student is required to complete courses worth approximately (not
more than) 30 university credits among the profile courses for the track in question.

3. Eligibility and selection

General eligibility requirements

A completed Bachelor’s degree (BSc, BEng of corresponding) comprising 180 university credits
from a university approved by the Swedish authorities or accredited of an authorized organi-
zation. Working knowledge in written and spoken English. The applicant must present proof of
knowledge in English. Complete information on the eligibility requirements can be found in the
local admission policy of KTH.

Specific eligibility requirements

The prerequisites for the Master’s program in Applied and Computational Mathematics is a
Swedish or foreign degree equivalent to Bachelor of Science of 180 university credits, with at least
45 university credits in mathematics. The students are required to have documented knowledge
corresponding to basic university courses in analysis in one and several variables, linear algebra,
numerical analysis, differential equations and transforms, mathematical statistics, and basics of
programming in a higher programming language.

The specific requirements may be assessed as not fulfilled if

• the average grade is in the lower half on the grading scale used (above pass level)
• the degree awarding institution is not considered to meet acceptable quality standards by
the authorities of the country in which the institution is located
• the degree does not qualify for admission to equivalent Master’s level in the country where
the degree is awarded

Selection process

The selection process is based on a total evaluation of the following criteria: university, grades in
courses relevant to the program: mathematics in a wide sense, and motivation letter. In addition,
English language skills above the minimum requirements will give a higher overall evaluation
score. Complete information on the eligibility requirements can be found in the local admission
policy of KTH.
4. Implementation of the education

Structure of the education

The duration of the academic year at KTH is 40 weeks. The academic year is divided into four periods. Each period is followed by an examination period. Apart from these examination periods, there are three re-examination periods. Teaching activities may, if necessary, be scheduled outside the academic year. Details about the structure follow the general rules stated by KTH.

Courses

The program is course-based. A list of courses is presented below.

Grading system

Courses in the first and the second cycle are graded on a scale from A to F. A-E are passing grades, A is the highest grade. The grades pass (P) and fail (F) are used for courses under certain circumstances.

Conditions for participation in the program

No later than November 15 and May 15 each academic year, respectively, the students are required to make a study registration and course selection for the coming term. At least 45 university credits have to be completed during the first academic year (including the re-examination period in August) in order for the student to be promoted to the second year of the program.

Degree project

Students admitted to the program are required to perform an independent study in the form of a thesis project corresponding to 30 university credits. The requirement of at least 60 university credits on advanced level and sufficient depth in the chosen track must be met before the thesis work can start.

The purpose of the thesis project is that the student should demonstrate the ability to perform independent project work, using and developing the skills obtained from the courses in the program. It is the student’s responsibility to find a suitable thesis project.

Degree

Students who fulfill all the requirements will be awarded a Degree of Master of Science (two years). Students must apply for the degree and also show proof of their basic degree (Bachelor’s or similar). Complete information on the degree requirements can be found in the local degree policy of KTH.

5. Courses and tracks

The program courses include 30 university credits worth of courses that are mandatory for all students of the program, and for each track approximately (not more than) 30 university credits worth of courses that are mandatory for that track. The courses not falling in either of the two categories above are optional courses that can be chosen freely if they are courses at the advanced level given by the department of mathematics. Courses worth 7.5 credits can be chosen freely. Courses corresponding to more than 7.5 credits in fields other than mathematics are typically accepted if those courses can be seen as a broadening of the studies towards an area where mathematics can be applied. Other choices of courses are possible when approved by the program director. Out of the 90 university credits courses, excluding the degree project course, at least two courses must be chosen that has project work as an essential part of the examination. Such courses are indicated with (P).
The following courses are mandatory for students of all tracks:

- AK2036 Theory and Methodology of Science with Applications (Natural and Technological Science), 7.5 ECTS, period 1
- SF2520 Applied Numerical Methods, 7.5 (3+4.5) ECTS, periods 1,2
- SF2812 Applied Linear Optimization, 7.5 ECTS, period 3 (P), or
  SF2832 Mathematical Systems Theory, 7.5 ECTS, period 2, or
  SF2863 Systems Engineering, 7.5 ECTS, period 2
- SF2940 Probability Theory, 7.5 ECTS, period 1

5.1. Requirements for the Master’s degree project

The course requirements for the course DN240X Degree project in computational mathematics, second level, are listed below. Responsible for the track Computational mathematics is Michael Hanke, hanke@kth.se.

- SF2561 The Finite Element Method, 7.5 ECTS, period 1 (P)
- SF2524 Matrix computations for large scale systems 7.5 ECTS, period 2 (P)
- SF2521 Numerical Solutions of Differential Equations, 7.5 (3.75+3.75) ECTS, periods 3,4
- SF2568 Parallel Computations for Large-Scale Problems, 7.5 (3+4.5) ECTS (P), periods 3,4

The course requirements for the course SF288X Degree project in Optimization and systems theory, second level, are three of the six courses listed below. Responsible for the track Optimization and systems theory is Xiaoming Hu, hu@kth.se.

- SF2812 Applied Linear Optimization, 7.5 ECTS, period 3 (P)
- SF2822 Applied Nonlinear Optimization, 7.5 ECTS, period 4 (P)
- SF2832 Mathematical Systems Theory 7.5 ECTS, period 2
- SF2842 Geometric Control Theory, 7.5 ECTS, period 3
- SF2852 Optimal Control Theory, 7.5 ECTS, period 4
- SF2863 Systems Engineering, 7.5 ECTS, period 2

The course requirements for the course SF299X Degree project in mathematical statistics, second level, are listed below. Responsible for the track Mathematical statistics and financial mathematics is Filip Lindskog, lindskog@kth.se.

For a degree project focusing on financial mathematics it is required that the student has passed the courses:

- SF2701 Financial Mathematics, 7.5 ECTS, period 4
- SF2942 Portfolio Theory and Risk Management, 7.5 ECTS, period 1
• SF2943 Time Series Analysis, 7.5 ECTS, period 4 (P) or SF2950 Applied Mathematical Statistics, 7.5 ECTS, period 3 (P)

• SF2980 Risk Management, 7.5 ECTS, period 2 (P) or SF2975 Financial Derivatives, 7.5 ECTS, period 3 (P)

For a degree project focusing on mathematical statistics outside the field financial mathematics it is required that the student has passed three of the following five courses:

• SF2943 Time Series Analysis, 7.5 ECTS, period 4 (P)

• SF2950 Applied Mathematical Statistics, 7.5 ECTS, period 3 (P)

• SF2955 Computer Intensive Methods in Mathematical Statistics, 7.5 ECTS, period 4 (P)

• SF2970 Martingales and Stochastic Integrals, 6 ECTS, period 2

• SF2980 Risk Management, 7.5 ECTS, period 2 (P)

Exceptions from these requirements can be given by the director of the program.

5.2. Optional courses

The following courses are among the optional courses:

• SF2701 Financial Mathematics, 7.5 ECTS, period 4

• SF2942 Portfolio Theory and Risk Management 7.5 ECTS, period 1

• SF2943 Time Series Analysis, 7.5 ECTS, period 4 (P)

• SF2950 Applied mathematical statistics, 7.5 ECTS, period 3 (P)

• SF2955 Computer Intensive Methods in Mathematical Statistics 7.5 ECTS, period 4 (P)

• SF2970 Martingales and Stochastic Integrals, 6 ECTS, period 2

• SF2972 Game Theory 7.5 ECTS, period 3

• SF2975 Financial Derivatives 7.5 ECTS, period 3 (P)

• SF2980 Risk Management 7.5 ECTS, period 2 (P)

• SF2561 The Finite Element Method, 7.5 ECTS, period 1 (P)

• SF2524 Matrix computations for large scale systems 7.5 ECTS, period 2 (P)

• SF2521 Numerical Solutions of Differential Equations, 7.5 (3.75+3.75) ECTS, periods 3,4

• SF2568 Parallel Computations for Large-Scale Problems, 7.5 (3+4.5) ECTS (P), periods 3,4

• DN2258 Introduction to High-Performance Computations, 7.5 ECTS (aug.) (P)

• DN2230 Fast Numerical Algorithms for Large-Scale Problems, 7.5 ECTS, period 2

• DN2295 Project Course in Scientific Computing, 7.5 ECTS (P)

• Advanced individual course in Scientific Computing, 6.0 ECTS (P)

• DD2257 Visualization, 7.5 ECTS, period 4

• SG2212 Computational Fluid Dynamics, 7.5 ECTS, period 3 (P)

• DD2435 Mathematical Modelling of Biological Systems, 9 ECTS, periods 1,2

• DD2431 Machine Learning, 6 ECTS, period 1

• SG2224 Applied Computational Fluid Dynamics, 5 ECTS, period 4 (P)

• BB2300 Computational Chemistry, 7.5 ECTS, period 2 (P)

• BB2440 Bioinformatics and Biostatistics, 7 ECTS, period 1

• BB2280 Molecular Modelling, 7.5 ECTS, period 2

• MH2426 Quantum Engineering Computations for Nanosystems, 7.5 ECTS, period 3

5(6)
• SD2611 Aerodynamic Design of Aircraft, 9 ECTS, periods 1,2 (P)
• DN2275 Advanced Computations in Fluid Mechanics, 7.5 ECTS, period 3 (P)
• DN2274 Computational Electromagnetics, 7.5 ECTS, periods 1,2 (P)
• DN2223 Topics in Scientific Computing, 3 ECTS (P) (compact course, one week in march and a project)
• DN2281 Computation Methods for Stochastic Differential Equations, 7.5 ECTS, periods 3,4
• SF1811 Optimization, 6 ECTS, period 2
• SF2812 Applied Linear Optimization, 7.5 ECTS, period 3 (P)
• SF2822 Applied Nonlinear Optimization, 7.5 ECTS, period 4 (P)
• SF2832 Mathematical Systems Theory 7.5 ECTS, period 2
• SF2842 Geometric Control Theory, 7.5 ECTS, period 3
• SF2852 Optimal Control Theory, 7.5 ECTS, period 4
• SF2863 Systems Engineering, 7.5 ECTS, period 2